PYROTECHNIC INITIATOR WITH ON-BOARD CONTROL CIRCUITRY

BACKGROUND OF THE INVENTION

[0001] The field of this invention generally relates to pyrotechnic initiators, and more particularly to an integral pyrotechnic initiator with control circuitry enclosed in a molded connector body.

[0002] Pyrotechnic initiators have many uses in industrial and consumer applications. One important use is the inflation of airbags in motor vehicles. A pyrotechnic initiator is placed in an airbag module. When ignited, the pyrotechnic initiator releases gas and heat that activates a gas generator (inflator), ruptures a sealed gas unit, or performs some other work that inflates the airbag. The pyrotechnic initiator is typically tightly secured to the inflator by one of a number of well-known attachment strategies. The pyrotechnic initiator is also electrically attached to control circuitry by a connector. As the number of initiators per automobile, enhanced control features, and low-energy firing features have all increased, initiators often referred to as "smart initiators" or "smart low energy initiators" ("SLEI") have been developed.

[0003] These smart initiators require control circuitry, such as a printed circuit board assembly (PCB), with active and passive electronic components. Such electronics require additional space inside the initiator, tending to increase the overall size of the initiator. Conventionally, the electronics have been incorporated between the ignition element and the gas seal area, with a PCB soldered to the output pins and the ignition element, encapsulated, and injection molded with nylon.

[0004] There are two main disadvantages to the existing design. First, the final assembly is larger than acceptable (especially for the driver's side) and requires re-

qualification of the inflators. Also any future growth of the electronics may require re-qualification of the inflator. The second disadvantage is that the electronics are placed inside the gas seal area and exposed to high stresses during installation, operation, and deployment. These conditions compromise long term reliability.

SUMMARY OF THE INVENTION

[0005] The present invention is directed to a pyrotechnic initiator having a molded body that encloses on-board control circuitry provided in the mating connector area, where the output pins are conventionally placed. This causes only minimal changes to the existing inflator design and configuration that do not require re-qualification. In a separate aspect of the invention, the on-board electronics may be pre-encapsulated or molded as part of the final assembly of the initiator. In another separate aspect of the invention, retention features of the header assembly may be transferred to the output can.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is a side view of a pyrotechnic initiator of the present invention.

[0007] FIG. 2 is a front view of the initiator of FIG. 1.

[0008] FIG. 3 is a sectional view taken through lines 3-3 of FIG. 1.

[0009] FIG. 4 is a sectional view taken through lines 4-4 of FIG. 2.

[0010] FIG. 5 is a top view of the initiator of FIG. 1.

[0011] FIG. 6 is a bottom view of the initiator of FIG. 1.

[0012] FIG. 7 is a sectional view of a mating connector with the connector end of the initiator of FIG. 1 inserted into it.

[0013] FIG. 8 is a front view of the mating connector of FIG. 7.

[0014] FIG. 9 is a sectional view similar to that of FIG. 7, but also showing the inflator into which the pyrotechnic charge-loaded end of the initiator of FIG. 1 is inserted.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0015] As can be seen from Figs. 1-9, in a preferred embodiment of the present invention, an initiator assembly 10 has a mating connector 80 and interconnections that are reconfigured in order to create space for an on-board PCB 30. Referring to Figs. 3 and 4, it can be seen that initiator assembly 10 includes a generally conventional ignition element comprising a header eyelet 44, ground electrode pin 22, glass insulator 48, and isolated electrode pin 21, and a pyrotechnic charge 46 enclosed in output can 42.

[0016] PCB 30, however, which includes a board 31 and electronic components 32, is enclosed by initiator molded body 20, and provided as an integral part of the initiator that can be supplied as one piece to inflator manufacturers. PCB 30 is placed outside the gas seal area, away from crimping stresses incurred during installation of the inflator 100 (see Fig. 9), and away from the high compressive loads of firing. Because PCB 30 is kept in a less exposed, less stressed part of the initiator, it has an increased chance of survival and communication after deployment of the airbag. Pins 21 and 22 are connected to initiator electrical interface 60, which is configured to slidingly mate with the mating connector (Figs. 7-9). It should also be noted that, as shown in the depicted embodiment, output can 42 and insulator cup 40 can be suitably flared at their bottoms to enhance their retention in initiator assembly 10.

[0017] Turning to Figs. 7-9, mating connector 80 includes a conventional bus wire 89, but has an enlarged opening 88 defined by connector molded body 85, and a bus wire electrical interface 90. Bus wire electrical interface 90 is preferably configured to

elastically deform enough to permit the connector end of initiator assembly 10 to be slidingly received, with initiator electrical interface 60 and bus wire electrical interface 90 held snugly together in secure electrical contact.

[0018] With a standardized interface between electronics and the inflator, several different types of PCB assemblies may be incorporated with an ignition element. The PCB may be produced by an outside vendor, encapsulated, and supplied to an initiator manufacturer who can then appropriately attach it to pins 21 and 22 and mold it for final assembly, such as by insert injection molding with suitable thermoplastic or thermoset material.

[0019] As a result of placing the control circuitry within the initiator in accordance with the present invention, the initiator and mating connector can have a beneficially compact overall size, and can, for example, be made with an overall axial length of under 21 millimeters.

[0020] A preferred pyrotechnic initiator having on-board electronics, and a mating connector therefor, and many of their attendant advantages, have thus been disclosed. It will be apparent, however, that various changes may be made in the form, construction and arrangement of the parts or in the steps of the process without departing from the spirit and scope of the invention, the form and process hereinbefore described being merely a preferred or exemplary embodiment thereof. Therefore, the invention is not to be restricted or limited except in accordance with the following claims and their legal equivalents.